APRIL 2017

PHASE 1

PENNDOT EXTREME WEATHER VULNERABILITY STUDY

APPENDIX A

DISTRICT OUTREACH MEETING MINUTES AND ATTENDEES

Michael Baker INTERNATIONAL

pennsylvania DEPARTMENT OF TRANSPORTATION

PennDOT Extreme Weather Vulnerability Study

District Outreach Meetings:
Attendance List and Meeting Minutes Summary

Provided in Order of District Number

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District 1 Meeting

District 1-0 Meeting
May 24, 2016
1:00 PM

pennsylvania
DEPARTMENT OF TRANSPORTATION
Michael Baker
INTERNATIONAL

PennDOT Extreme Weather Vulnerability Study

Meeting Attendance Record

Name	Title	Agency	Telephone	Email
BLAINE SHICK	ACMM	PA DOT	814 723-3500	bshick@pa.gov
DOUG SCHOFIELD	ADE-M	PA DOT	814 678-7140	dschofield@pa.gov
Michael Shanshala	MSE	PA DOT 10-0	724 357 2819	Mshanshala@PA.gov
Darrell R. Chapman	SCHMM	PennDot 1-4	724-269 1061	dachapman@pa.gov
Christopher Friday	MPO Admin	Erie County	814-737-2646	cfriday@eriecountypa.gov
Allen Clark	Director	Crawford EMA	814-724-2552	aclark@co.crawford.pa.us
SUE SMITH	RPO	NW COMMISSION	814-6774800	suesse@northwestpa.org X131
Bill Keller	Dist Br. Eng	PA DOT	814-678-7106	wkeller@pa.gov
Garrett M. Westover	CMM	Venango PennDot	814-673-6155	gwestover@pa.gov
Jason Daley	Geotech	PB Dot	x7027	jdaley@pb.com
ADAM ELMS	CMM	"	8147233500	aelms@pa.gov

PennDOT Extreme Weather Vulnerability Study
District 1-0 Meeting Notes
May 24, 2016 (1:00PM)

Participants:

- See attendance sheet
- Agency provided introductions and their agency's level of involvement in transportation resiliency. Examples included:

Agency/Department	Examples of How Agency has Addressed Resiliency
ADE-Maintenance	• Agency is at an Awareness and Assessment level • Own 2 portable bridges to address bridge closures
District Geo Tech	• Know location of slides, present at planning meetings with suggested fixes, MPO can prioritize projects

Extreme Weather Vulnerabilities:

Data Sources for Vulnerability Locations:

- District staff may have listings of flooding areas (will follow-up)
- District has database of top slide locations (should be included in vulnerability assessment)
- PennDOT Plant Maintenance Records
    - Contains materials, repairs, traffic control used for events
    - Used to record costs
    - Should include State Route, Segment, and Offset
    - Crystal Reports can be run – talk to Shawn Crane / Mike Long

Extreme Weather Impacts in Region:

- Snow belt areas of I-79 causes short term impacts
- Flooding impacts in region are usually minor
    - Temporary flooding, place signs, most have alternative routes, most minor roads
    - Flash flooding is the most problematic – small footprint
    - Have had some smaller bridges / pipes washed out
    - Flash floods on 4 digit SRs a problem. Three bridges out in Forest County at one time. 200' section of 322 out for 15 minutes
- What is likelihood of Agnes flood?
- Stream debris has caused many issues. Typically difficult to address debris issues outside of PennDOT right-of-way. Permits often needed.
- Slides are a key issue in region
    - Example: lost 200feet of US322
- Debris is often the cause of problems, not the flooding
- Ice dams (example Oil City – controls in place to reduce impacts)
- No tornado damages to bridges to date

    - Question – are there standards for inspection of bridges or earthquakes?
- Have had occasional joint failures due to heat.
- Army Corps of Engineers has worked to solve issues related to Union City Dam
- Down trees often cause roadway blockages
- Snow load on bridges is an issue
- Inlet boxes filled with snow and a spring thaw becomes an issue.
- DEP permitting of stream dredging to remove silt an issue.
- Wind – no protocol for inspections of infrastructure
- Winter of 1977-78 was extreme event
    - District has not seen the intensity duration of that event – would be interested in understanding the probability of this event
- Focus on removal of snow quickly from bridges during sudden snow events
- Beaver dams have caused problems at select locations when water released.
- Unknown of what snowfall it would take in inches to overwhelm District staff. Could vary by region. Storage of snow a key issue (e.g. Erie has many places to move snow to)
- Logging / Gas / Cell Tower industry have built roads that have caused runoff issues. They have received HOP permits but do not always meet drainage requirements.
- Retaining wall failures have caused roadway closures

Strategies to Improve Resiliency:

Examples of Existing Strategies:

- District design staff is communicating with maintenance staff – part of normal scoping process
- Detour routes have been mapped for locations of flooding
- Marking repairs at a higher standard (including types of rock)
- Two portable bridges (40ft span)
    - Have been used to help a land locked community
    - Provides access for fire and ambulance
- RCRS system provides methods to share information on closures
- Roadway closures go to 511 to provide public alerts.
- Protocols exist for communication between PennDOT and municipalities. PennDOT coordinates with County EMA who then helps with dissemination of information to locals.
- Installation of permanent signs in flood prone areas. Drop down warning during flooding; raise up signs afterwards. This would free up personnel to perform other work instead of manning blocked roadways.

Other Potential Strategies:

- Need to armor banks of small streams next to roads to prevent washouts
- Potential updates to RCRS – but don't burden staff
- Supplying ways that locals can provide more information on their flooding locations may be useful to PennDOT (e.g. webtool). For example, if PennDOT upsizing pipes they can start to understand downstream impacts on other systems.
- Better support for local stormwater management

- More effective public involvement could be accomplished if more used 511.
- More linkages to NOAA weather data to closure data
- We need to size pipe from a watershed approach. State and local coordination.
- Design / maintenance/ construction field views to account for current / future flooding
- Map detour routes next to flood prone assets

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District 2 Meeting

District 2-0 Meeting
May 10, 2016
1:00 PM

pennsylvania DEPARTMENT OF TRANSPORTATION
Michael Baker INTERNATIONAL

PennDOT Extreme Weather Vulnerability Study

Meeting Attendance Record

Name	Title	Agency	Telephone	Email
Dave Matheson	acting ADE	D.O. 2-0	(814) 7650486	dmatheson@pa.gov
Mark Heisey	HMM	Mifflin/Juniata	717-363-1093	mheisey@pa.gov
Russell Halfpenny	HMM	Mifflin Co.	(717)363-1108	R.halfpenny@Pa.gov
Jeff Collins	ACMM	Centre	8149331617	jecollins@pa.gov
Howard D. Lidgett	ACMM	Clearfield	814 577-2794	holidgett@pa.gov.
Tim Tekely	CMM	Clearfield	814 577-2793	ttekely@pa.gov
Adam Bechdel	ACMM	Clinton	570-660-7811	adbechdel@pa.gov
LISA CLARK	GIS	Mifflin County	(717) 248-9645	lclark@co.mifflin.pa.us
BRIAN FLEEGAL	911 Supervisor	MIFFLIN County	717-248-9645	bfleegal@co.mifflin.pa.us
George Uhl	Asst Bridge Engr	District 2-0	(814) 765-0483	guhl@pa.gov
Tom ZURAT	Portfolio MANAGER	DISTRICT 2-0	(814) 762-5037	TZURAT@PA.GOV
Don Maichi	RTMC Supervisor	District 2-0	(814) 7682-3082	DOMAICHI@PA.GOV
Marla FANNIN	CRC2	District 2-0	814-765-0423	MFANNIN@pa.gov

Name	Title	Agency	Telephone	Email
KURT BARCLAY	GIS DIRECTOR	NC RPO	814.773.3162	KBARCLAY@NCENTRAL.COM
GEORGE PRESTASH	ACTING ADE DESIGN/ PE ENGR D-2	D-2	814-765-0479	gprestash@pa.gov.
DENNIS M PRESTASH	RTMC MANAGER	D-2	814-765-0402	dPRESTASH@PA.GOV
GREG SAYERS	MAINT OPS	D-2	814-765-0489	gsayers@PA.GOV
SCOTT MAJOT	PENN DOT	2-4/2-6	814-274-9181	S.MAJOT@PA.GOV
Brian Gresco	Penn DOT	D-2	814 765-0463	bgresco@pa.gov
VICKIE RUSNAK	TPH	D-2	814-765-0444	virusnak@pa.gov
Dave Mader	Maint Agty	D-2	814 765-0491	dmader@pa.gov
ERIK BROWN	DISTRICT TRAFFIC ENG.	D-2	814 765-0498	eribrown@pa.gov
Mike Bloom	[redacted] Planner	Centre Co. MPO	814-355-6791	dmbloom@centrecounty pa.gov
JIM SAYLOR	TRANS PLANNING DIR	SEDA-COG MPO	570 524 4491	jsaylor@seda-cog.org

PennDOT Extreme Weather Vulnerability Study
District 2-0 Meeting Notes
May 10, 2016 (1:00PM)

Participants:

- See attendance sheet
- Agency provided introductions and their agency's level of involvement in transportation resiliency. Examples included:

Agency/Department	Examples of How Agency has Addressed Resiliency
Maintenance Operations	• Awareness of extreme weather issues • Conduct post event reviews
ADE / County Manager	• High-level of awareness • Upsize of pipes and swale retention
Potter County Maintenance Manager	• Use of riprap • Raise pavements in flooded areas
District Materials - GeoTech	• Database of impacted areas • Regular inspections • Ratings by risk • Works with County Manager
Planning Manager	• Work with County Manager • Projects on LRTP for repeat flooding areas • Linking planning and NEPA
ADE - Design	• Inspection teams made aware of flooding locations • Work with Central Office to manage resiliency
Maintenance Program Manager	• Struggle to adopt strategies due to funding issues
District Traffic Engineer	• Traffic Management Center shares data with county on detours/ITS • RCRS provides key data and locations
Centre MPO	• Works with District Planning Manager • Aware of problem areas • Important linkages to hazard mitigation plan • TIP/LRTP programming
SEDA COG	• Trying to do more assessments • 8 county layer of critical facilities prepared • Would like to use more with RCRS • Looking for funding options – would like study to address potential funding sources
Mifflin – Juniata Maintenance Manager	• Using RCRS • Maintenance staff no locations that flood after events
Centre County	• Problems in State College due to development
Clearfield County Manager	• Awareness of issues by season • Check pipes at high vulnerable locations

Clinton County	• Audit review • Make changes as necessary to pipes
Mifflin County GIS	• GIS layers for critical infrastructure
Assistant Bridge Engineer	• Doing bridge scour inspections according to Publication 23 and 238 • Website on plan of actions for scour bridges • Use RCRS • Evaluate weather and scour conditions – contact locals
Design Manager	• Trying to identify changes to design manual • Talking to maintenance / evaluating design criteria
TMC	• Action reviews after events • RCRS data usage and entry
District Press Office	• Focus on relaying information to public
RPO	• Tech assistance and tools to help locals
District 10 Maintenance Services Engineer	• I80 Clarion County Reconstruction included 2 million dollar drainage system • Upsizing pipes, Riprap • Directive on use of pipes • Concerns over plastic pipes at some locations • Impacts of Dams

Extreme Weather Vulnerabilities:

Data Sources for Vulnerability Locations:

- PennDOT Road Closure Data
- District Traffic Management Center (TMC) has information/data of events
- Maintenance personnel know key locations
- County and Township Staff (locals know the issues)
- District 2-0 has a slope failure database. Criteria could help us identify high risk assets.
- Contact 911 Centers to determine tracking of flood prone areas
    - No statewide database
    - 67 911 centers
    - PEMA may not have this data aggregated
    - If PennDOT wishes to obtain … best to coordinate efforts through PEMA
- Chesapeake Bay data (Jim Saylor)
- Develop one pager to help communicate with the locals regarding information sharing and data collection

Extreme Weather Impacts in Region:

- Primary concern is extreme flooding
    - Heavy rain impacts bridges with critical scour ratings
    - Inspections required – use of divers has been used in this District
    - Flooding concern in mountain valleys
    - Flooding often winter event with large snow amounts followed by rain (1996, 2010)

    - 1996 flood closed Route 6 (piers lost at bridge)
    - SR 120 flooding in Emporium
- Extreme heat occurs once every 10 years or so.
    - Has impacted state routes 219 and 255 (joint expansion of 2-3 feet). Required methods to cut pavement relief joints.
    - CMU is doing research on pavement design and extreme heat.
- Snow and ice also important climate stressors to consider. Snow has had major impacts on seven mountains annually.
- Local storm water management plans impact state storm water management system
    - Adherence to plans is limited
    - Storm drains in cities, class 1 townships starting to collapse. Tough to install open swales off of PennDOT ROW. Need collaboration between state and local agencies.
- DEP permit allows logging roads to discharge on highway causing mudslide issues
- Rockslides are also issues related to weather
    - District 2-0 has a slope failure database. Criteria could help us identify high risk assets.
- Should factor in dams
- Can we learn from Nuclear Power Plant Evacuation Planning

Other Asset Characteristics That Impacts Vulnerability:

- No additional items provided

Critical Assets:

Factors Affecting Determination of Critical Assets:

- Criticality is in the eye of the beholder. Develop criteria that we can live with. (Graph depicting Vulnerability on the Y axis and Criticality on the X axis)
- Include probability of event in criteria
- Detour length if a bridge is out is an important criteria. This information can be obtained from PennDOT's Bridge Management System.
- Scour Critical Bridges should be one of the criterion
- The location of schools and hospitals should be considered in critical asset assessments.
- Costs should be factored into priority decision making.
- Whether route functions as a designated detour route.

Examples of Critical Asset Data Sources:

- PennDOT Business Plan Network
- Transearch Data for freight items
- CENSUS LEHD
- PennDOT Bridge Management System
- Review Winter Maintenance Database (Snow Route priorities)

Strategies to Improve Resiliency:

Examples of Existing Strategies:

- Check ECMS – it has a list of project best-practices for every District. See the Resources Area / Document / Maintenance Design and Construction

- Coordination and Training
  - Proactively track storm events. Conduct preplanning of events before they occur. Conduct coordination efforts to ensure proper response.
  - Education for municipalities for scour critical monitoring and how to check after major weather events.

- Data Analyses and Information Sharing
  - Track scour ratings on bridges. Every month run database to see if changes and how that might affect the action plans.

- Maintenance and Inspections
  - Debris clearance before major events.
  - Have plan of where to obtain equipment if needed quickly after a storm event.
  - When developing consultant contracts, ensure to include extra work units/time in case events happen. Helps ensure that inspections can be conducted quickly.
  - Inspectors in District 3 test stream depths to identify if streambed impacted by large weather events and flooding.
  - Documentation of pre-event conditions to understand impact of storm event.

- Design
  - End walls on culverts to prevent floating.

Other Potential Strategies:

- Coordination and Training
  - Combine strategies as part of Hazard Mitigation Plan
  - Consider conducting quarterly meeting with PEMA regarding vulnerability and criticality
  - Get locals involved with situational awareness, inspection, etc.
  - Coordinate with locals when repairing state roadway pipes. If adjoining local infrastructure is not repaired or maintained, this can impact PennDOT's improved drainage systems resulting in damage. Possible agreements with both locals and PennDOT to update adjoining infrastructure concurrently (though locals lack funding).

- Data Analyses and Information Sharing
  - Incorporate District 10-0 strategies to reduce buckling of pavement on I 80 due to extreme heat.
  - Develop LPN Layers for flooding vulnerabilities, critical for scour, economic development, emergency response, medical emergencies, intermodal connectors, etc.

- Maintenance and Inspections
    - Continue to improve post flood inspection process.
    - Address the scour issues before storm events. Early maintenance including rip rap to keep scour impacts minimal.

- Design/Technology/Equipment
    - Leafless grate on storm drains
    - Modify bridge design curves to factor in extreme flooding. (What is new 100 year storm?)
    - Take advantage of research on pavement design for extreme heat

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District 3 Meeting

District 3-0 Meeting
May 13, 2016
1:00 PM

PennDOT Extreme Weather Vulnerability Study

Meeting Attendance Record

Name	Title	Agency	Telephone	Email
Paul Mitchell	AHMM	DISTRICT 0370 TIOGA	(570) 724-4142	pmitchell@pa.gov
Carey Mullins	Trans. Planner	PennDOT CO Program Center	717-783-2265	Cmullins@pa.gov
John Pagano	AHMM	0370 Tioga	570-724-4142	johnpagano@pa.gov
CIAI PAINE	AHMM	0380 UNIon	570-523-0841	CL PAINE@PA.gov
Jacky Cain	AHMM	0390	570 265 2181	jocain@pa.gov
Bobby Eisley	AHMM	0370	570-724-4142	beisley@pa.gov
MIKE MAUSTELLER	PME	0300	570 368 4396	mmaustelle@pa.gov
Jared A. McMicken	CMM	0390	570-265-2181	jmcmicken@pa.gov
ERIC HIGH	ADE-M	0300	570 368 4259	ehigh@pa.gov
John A Stabinski	ACMM	0310	570-387-4250	jstabinski@pa.gov.
Shawn L. Hill	SHMM	0310/0330	570 387-4250	shahill@PA.gov
KEN POCHATKO	SHMM	3-2/3-6	368-4282	kpochatko@pa.gov
WAYNE WAGNER	RPC	3-2/3-6	368-4263	WAWAGNER@PA.GOV

Name	Title	Agency	Telephone	Email
Jeff Beattie	ACMM	Penn DOT	570-368-4286	jebeattie@pa.gov
Ken Bair	MSE	PennDOT 3-0	570-368-4266	kbair@pa.gov
Mark Verrico	CMM	PennDOT 3-7	570-971-8066	Mverrico@pa.gov
MICHAEL MCWILLIAMS	AME	PennDOT 3-0	570-368-4226	mmcwilliam@pa.gov
ALAN KELLER	DTE	PennDOT 3-0	570-368-4260	alakeller@pa.gov
Matt Williams	Planner	Northern Tier RPO	570-265-1532	williams@northerntier.org
John Stetts	AME	PennDOT 3-0	570-368-4274	jstetts@pa.gov
Grant Williams	GIS Analyst	Lycoming Planning	(570) 320-3141	gwilliams@lyco.org
Mark Murawski	Trans. Planner Co.	" "	(570) 320-2138	MMurawski@lyco.org
Frances M. Funken	Dep. Director	Lyc Co. Plan	(570) 320-2139	fmfunken@Lyco.org

PennDOT Extreme Weather Vulnerability Study
District 3-0 Meeting Notes
May 13, 2016 (1:00PM)

Participants:

- See attendance sheet
- Agency provided introductions and their agency's level of involvement in transportation resiliency. Examples included:

Agency/Department	Examples of How Agency has Addressed Resiliency
PennDOT District 3-0 Southern	• Focuses on quick response (Reactionary role) • Work to acquire federal funding for repairs
PennDOT District 3-0 Maintenance	• Focuses on quick response to ensure public safety • Checking of storm drains before storms to make sure clear
PennDOT Bridge Engineer	• Assess impacts of flooding • Identifies locations of slope failure
Lycoming County Planning	• Update insurance maps and depth grids • MPO runs local bridge inspection program and arranges inspections • Assists in getting funding • Involved with emergency operations and activates 911 center • GIS department has identified flood risks and depth of flooding
SEDA-COG	• Addresses resiliency in the project prioritization process • Needs better access to RCRS information
County Managers (Tioga, Columbia, Union)	• Monitor extreme weather • Enter RCRS information • Oversee planning for winter events • Materials management (salt) • Training for incident management • Contingency plans (detours) • Learning from Hurricane Lee and Irene events • Assess bridge scour ratings
Bradford County	• Identified low lying areas in the county • After action reviews are important – utilizing technology cameras and tablets with lat/long
Tioga County Maintenance	• Developed contingency plans
Traffic Engineer	• Develops emergency detours during events and long term traffic control for after events
Northern Tier RPO	• Incorporate resiliency into the TIP and LRTP • Secure emergency grants for stream repair

Wyoming County Maintenance	• Inform public of conditions
Luzerne County Maintenance	• Monitors roadways based on river levels • Inspects bridges when bridges are topped • Documents conditions with pictures in order to receive federal funding
Sullivan County	• Mobile emergency teams used by most districts

Extreme Weather Vulnerabilities:

Data Sources for Vulnerability Locations:

- GeoSnap Application
  - Enables users to photograph damage with latitude and longitude attached to the picture
  - Linked to Maintenance IQ through Harrisburg BOMO
  - Christie Fisher PennDOT Mobile Application Construction Team
- District has a database (EXCEL) file of all locations where contracted repairs were done. Can provide this as example for study
- Lycoming County Planning has DVD with PASDA information and GIS analyses (provided)
- Prioritization spreadsheet to track active slides

Extreme Weather Impacts in Region:

- Hurricane Irene greatly affected this region
  - 13 bridges destroyed and $60 million in flooding damage
- Ice is another issue facing this region
  - Ice jams occur on the smaller bridges
  - Deicer is sprayed on bridges
- Small tornados have occurred in the region
- Airport has had flooding problems
- SR 287 flooding

Other Asset Characteristics That Impacts Vulnerability:

- Direction of storm
  - If a storm follows a drainage system, damage is much worse

Critical Assets:

Factors Affecting Determination of Critical Assets:

- Need to weigh length of alternative routes and volume of traffic

Strategies to Improve Resiliency:

Examples of Existing Strategies:

- Removed high scour rated bridges
    - No high scour rated bridges remain along state roads
- Coordination
    - Coordinates with State Police prior to winter each year
    - During Hurricane Irene, DEP Official remained in the PennDOT office to provide emergency permits
- Pre-established emergency routes
    - During Hurricane Lee the evacuation routes became flooded … can learn from this storm how additional evacuation routes may be needed (must deal with weight restrictions for trucks also)
- Underwater bridge inspectors
- Work successfully with DEP to obtain permits quickly
- Each county maintains contacts with PSP during events
- After Action Reviews are important
- Continuity of operations plan to maintain redundancy of stock pile and emergency materials
- ITS deployment
- Use of technology (apps with locations e.g. GEOSNAP)
- Channel Cleaning
    - Currently clean 50 feet around a bridge
    - Not permitted to perform maintenance on streams outside of bridges the districts maintains, thus minor streams aren't cleaned anymore.

Other Potential Strategies:

- Increased funding for projects
- Design Standards
- COOP Planning
- Cooperation between National Guard and PennDOT

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District 4 Meeting

District 4-0 Meeting
May 13, 2016
8:00 AM

PennDOT Extreme Weather Vulnerability Study
Meeting Attendance Record

Name	Title	Agency	Telephone	Email
STEVE PITONIAK	PLANNER	LACKAWANNA CNTY PLAN COMMISSION	570-963-6462	PITONIAKS@LACKAWANNACOUNTY.ORG
SAM GALANTE	SHMM	PennDOT-4-3	570 876-2386	SGALANTE@PA.GOV
Paul Johnson	EMA Coordinator	Susquehanna County	570-278-5914	pjohnson@susqco.com
GARY BORZYCKI	ASST DIST BRDGE ENG	PENNDOT 4-0	570 963 3513	gborzycki@pa.gov.
Allen Jones	ACMM	Penndot 4-2	570-846-6965	allejones@PA.Gov
Elwood Litvin	ACMM	PennDOT 4-5	570-278-1171	elitvin@pa.gov
MANUEL MENENDEZ	ACMM	PENNDOT 4-7	570-836-3141	mmenendez@pa.gov
Jeff Luongo	ACMM	PennDOT 4-0	570 499-3879	jluongo@pa.gov
Brian Small	AHMM	PennDOT 4-5-7	570 278 1171	bsmall@pa.gov
CRAIG RICKARD	PLANNING DIRECTOR	WAYNE COUNTY	570-253-5970x4060	crickard@waynecountypa.gov
Chris Barrett	Asst. Dir. Planning/GIS	Wayne County	253-5970 Ext. 4060	cbarrett@waynecountypa.gov
Robert A. Kretschmer	Acty Mgmt Seminar Eng.	PennDOT 4-0	570-963-4067	rokretschm@pa.gov
Brian Baker	Planner	NTRPDC	570-365-1540	bakerb@northeastertier.org

Name	Title	Agency	Telephone	Email
Richard Bohr	District 4-0 Geotechnical Engineer	PennDOT 4-0	(570)963-4023	rbohr@pa.gov
Craig Pezak	Geotech. Eg. Intern	PennDot 4-0	–	cpezak@pa.gov
Martha Feisel	AHMM	PennDOT 4-3	5708262386	mfeisel@pa.gov
Bob Thorne	CM	Penndot 4-3/7	570-278-1171	RThorne@PA.gov
DAN FOX	TCSS	PENNDOT 4-0	570-963-4056	DAFOX@PA.GOV
Douglas Yacubaski	ACMM	PennDOT 4-3	570 2674827	dyacubaski@PA.gov
DAVE MACIAK	CMM	PENNDOT 4-2	570 586 2211	DMACIAK@PA.GOV
KEN THIELE	CMM	PENNDOT 4-4	570-296-7193	kthiele@pa.gov
Gene Dziak	Director WYO.CO Ema	WYO.CO. Ema	570-836-2828	weema01@wyco.org
DAVID CARICHNER	WYOMING CTY EMA Deputy Director	WYOMING CTY EMA	540-836-2828	wcema02@wycopa.org
George Roberts	DE Transportation Planner	PennDOT 4-0	570-963 4010	gwroberts@pa.gov
Chris Chapman	[redacted] Planner	LCRPC	570-963-6400	Chapmanch@lackawanna.org

PennDOT Extreme Weather Vulnerability Study
District 4-0 Meeting Notes
May 13, 2016 (8:00AM)

Participants:

- See attendance sheet
- Agency provided introductions and their agency's level of involvement in transportation resiliency. Examples included:

Agency/Department	Examples of How Agency has Addressed Resiliency
PennDOT TMC	• Enter information into RCRS
Susquehanna County Emergency Management	• Determine how to get first responders to locations of need when normal transportation routes cannot be used
Lackawanna County Manager	• Proactive stocking of materials
Wyoming County Maintenance	• Inform public of conditions
District Geotechnical Engineer	• Develops maintenance scenarios
Northern Tier RPO	• Incorporate resiliency into the TIP and LRTP
Luzerne County Maintenance	• Monitors roadways based on river levels • Inspects bridges when bridges are topped • Documents conditions with pictures in order to receive federal funding
Lackawanna County	• Coordinated with EMA and other agencies • Better coordination needed with locals in getting roads open after closures
Lackawanna County Planning	• Incorporate resiliency into the TIP

Extreme Weather Vulnerabilities:

Data Sources for Vulnerability Locations:

- Project Downpour
  - PennDOT Central Office rates and monitors every bridge. PennDOT sends out the list of bridges based on how often and when the bridges need to be inspected
  - SCDI code is made up of many different categories
- RCRS Data
  - Counties call into TMC and TMC enters the information into the RCRS database
  - Database is not a complete source of road closures due to absence of non-state roads
  - In this area, RCRS data has not been used for planning purposes
  - RCRS data could be improved by incorporating more details, such as why the road is flooded, and using dropdown menus instead of blank text boxes

Extreme Weather Impacts in Region:

- Excess rain and snow are key issues in region
- District 4-0 experienced an earthquake recently
    - There was no plan in place to determine at what severity, inspection of bridges needed to occur
- Utilities are often key reason roads are closed for extended times and create safety issues:
    - County Maintenance does not have access to the utility company and cannot work directly on site from them
    - Reopening takes longer when the main impact of the storm is in a different areas because the utility companies take care of the main impacts first
- Rockfalls and mudslides are other issues in the region

Critical Assets:

Factors Affecting Determination of Critical Assets:

- Detours
    - Weight restrictions along routes
    - The longer the detour, the more critical the asset is
- Evacuation
    - Need to determine if asset is along evacuation route

Examples of Critical Assets and Data Sources:

- Assets are affected differently based on whether they receive 3 inches of rain in 3 hours or 3 inches of rain in 24 hours
- Risks and criticality needed less for maintenance as they address issues as they come up

Strategies to Improve Resiliency:

Examples of Existing Strategies:

- Channel Cleaning
    - Currently clean 50 feet around a bridge
    - Not permitted to perform maintenance on streams outside of bridges the district maintains, thus minor streams aren't cleaned anymore.
    - More local maintenance needed of channels – though they need resources
- TMC
    - Having one point of contact for road closures is important
    - TMC does help get utility response if closure over 4 hours
- Storm preparations
    - National Weather Service offers a WebEx before large rain storms. Acuuweather/NOAA offers a WebEx before snow events.

- On days of large storms, County Maintenance has one person at the office answering phones until storm is over.

Other Potential Strategies:

- Minor Stream Alignment
  - Counties would like to do a minor stream alignment to get rid of right angle hits along roadways, but cannot get the permitting. They are able to receive funding in stream restoration and redirecting to where it belongs, but after 1,100 feet the Army Corps of Engineers becomes involved.
  - In Wyoming getting DEP permits works well. Processes with Army Corps takes much longer and may require additional study
  - Eugene Dsziak can provide a resource on above issues based on his experience

- Coordination between State Police and TMC
  - State Police does not share information on road closures with TMC (sometimes if not on cameras they receive information very late)
  - TMC has had meetings with the State Police in the past, but coordination has decreased recently. Need protocols to improve this coordination in this region.
  - TMC and EMA have good coordination. PennDOT has staff at EMA during events.

- Bridge Design
  - Debris often gets caught on center pier of bridge. Designing a bridge with no center pier would prevent debris issues.

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District 5 Meeting

District 5-0 Meeting
June 3, 2016
9:00 AM

PennDOT Extreme Weather Vulnerability Study

Meeting Attendance Record

Name	Title	Agency	Telephone	Email
Jack Hubbard	Dist. Maint.	PennDOT Transportation	610-871-4142	johubbard@pa.gov
Rodney VanScavis	SMM	5-5	484 541 1160	rvanscavis@pa.gov
Corey Repp	AHMM	5-2	484-602-8852	crepp@pa.gov.
Todd Hoch	AHMM	5-4	5706405507	TOLYON@PA.GOV.
NICK TYLENDA		NORTHAMPTON COUNTY EMA	610-746-3194	NTYLENDA@NCEM-PA.ORG
William Hillanbrand		Northampton Co. Emer. mgmt	610-746-3194	whillanbrand@ncem-pa.org
Michael Rampulla		Northampton County EMA	610-746-3194	mrampulla@ncem-pa.org
Matthew T. Stairiker	Dep Director	Berks County DES	610-374-4800	MStairiker@countyofberks.com
Donnie R Swope	Planning Mgr	Berks DES	6103744800	dswope@countyofberks.com
Dave Bernyman	Trans. Plan'r	RATS	6104786300	dbernyman@countyofberks.com
Alan Piper	~~TP III~~	Berks Co PC RATS	"	apiper@countyofberks.com
KEVIN MATTHEWS	DBMC	5-0	610-871-4163	KEVMATTHEW@PA.GOV
Dennis Toomey	Traffic Unit	5-0	610-871-4475	dtoomey@pa.gov
JEFF RAI	ASS'T DIST. BRIDGE ENGR	5-0	610-871-4523	jrai@pa.gov

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Name	Title	Agency	Telephone	Email
KAMLESH A. ASHAR	Bridge Engr.	DIST 5-0	6108714575	Kashar@pa.gov
Jerry Neal	ENV MGR	DISTRICT 5-0	6108714457	eneal@pa.gov
TIM FEHR	AHMM II	5-3 LEHIGH	610 798 4280	TIMO FEHR @ PA.GOV
RAY GREEN	TRANSPORTATION PLANNER	CENTRAL OFFICE	7177872378	raygreen@PA.gov
Michael Feryo	AHMM	5-1 Berks	610-929-0766	m.feryo@pa.gov
Kevin D. Kull	ACMM	5-6	570-385-7812	KKULL@PA.GOV
JERRY LOFTUS	HEM II	5-6	570-385-0804	GLOFTUS.PA.GOV

PennDOT Extreme Weather Vulnerability Study
District 5-0 Meeting Notes
June 3, 2016 (9:00AM)

Participants:

- See attendance sheet
- Agency provided introductions and their agency's level of involvement in transportation resiliency. Examples included:

Agency/Department	Examples of How Agency has Addressed Resiliency
ADE Maintenance	• Prepare for road closures • Mostly reactionary
Traffic Engineer	• Knowledge of road closures • Diversion routes planned
MPO	• Region most impacted by Ivan, Floyd, Sandy • Working with program center to address issues • New goal for project prioritization
Program Center	• Set aside funding for bridge/slides/floods • Helping to address quick needs

Extreme Weather Vulnerabilities:

Data Sources for Vulnerability Locations:

- PEMA Knowledge Center a good source of real time flooding data (historic?)
- NWS GIS layers good source for historic flooding
- Map flood gauges over the RCRS data
- CDART could be used to track accidents due to flooding

Extreme Weather Impacts in Region:

- District inspected bridges after earthquake a few years back.
- Fox an issue in Schuylkill County (especially along I81). County has worked to improve delineation and use message boards.
- Utility company coordination
    - GPU excellent to work with
    - PPL and Verizon difficult to get timely response
- Much of Verizon's issues occur since their work is turned over to subcontractors which have slowed response rates.
- Historic locks near Rt. 611 are an issue
- Rock slides are an issue in Carbon County during thaw/heavy rain conditions. County studying locations.
- Snow squalls have impacted I78. Limited detour options.
- Other state dams discharges into the Delaware has been an issue.

- Tropical storms have had impacts in region. Hurricane Lee closed portions of I81.
- Ice damming
- ACOE release of water into Blue Marsh creates back water issues on Rt 183.
- Storm sewer backup has created issues on several roads.

Consequence:

- Understanding risk for response may be different than for design
- Consider watershed approach

Strategies to Improve Resiliency:

Examples of Existing Strategies:

- Representatives from utility companies attend EOC. Effective way to coordinate work with downed trees.
- Pipes were upsized after Ivan storm

Other Potential Strategies:

- Improve RSS feed from RCRS to public and counties
- Additional temporary signage or other permanent sign options
- Clean inlets before events
- Funding and grant options – better understanding
    - Severe Repetitive Loss Grant Program
- Clear trees (daylighting of roadways) – more funds needed for these programs
- Be proactive with utilities
- Redundant design of assets
- Use of vulnerable locations for emergency planning purposes

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District 6 Meeting

District 6-0 Meeting
June 21, 2016
10:00 AM

PennDOT Extreme Weather Vulnerability Study

Meeting Attendance Record

Name	Title	Agency	Telephone	Email
Scott Bittner	Mgr	Bucks Co. Mgmt	215-345-6060	Sbittner@pa.gov.
Ed Park	ACMM	Delco 63	4105660972	epark a pa.gov
CHRIS GRIM		PEMA	610-562-3003	chgrim@pa.gov
BOB KENNEDY	CMM	0620	484.340-3201	robKennedy@pa-gov
Chris Bonenberger	AM MM	6-4	6105677857	Cbonenberg@pa.gov
C. Caton	Infrastructure PM	Phila OEM		Carolyn.caton@phila.gov
Steve Austin	CMM	Penn D.t 06	610 2056987	steaustin@pa.gov
RODNEY STITH	ACM	6-5	2157832313	ROSTITH@PA.GOV
CHRIS LINN		DVRPC	215 238 2873	clinn@dvrpc.org
SHAWN MEGILL LEGENDRE		DVRPC	215 238 2934	slegendre@dvrpc.org
James Fogel	High. Maint. Man	PennDOT	610-205-6869	jfogel@pa.gov
MIHAL SARNESAK	CIVIL ENG	"	610-205-6546	MSARNESA@pa.gov
John Kratzyk	ADE-M	"	610-205-6750	jKratzyK@Pa.Gov
Kevin Sutton	Bridge Unit	"	610-205-6629	KSutton@Pa.gov

Name	Title	Agency	Telephone	Email
Lynn Ryan	SHMM	PADOT	6102076235	lryan@pa.gov
ROB GRAFF	MANAGER, OFFICE OF ENERGY & CLIMATE CHANGE	DVRPC	215-238-2826	RGRAFF@DVRPC.ORG
Michael Zaccagni	Ch of Staff	Phila MOO	215 686-3445	Michael.Zaccagni@phila.gov

PennDOT Extreme Weather Vulnerability Study
District 6-0 Meeting Notes
June 21, 2016 (10:00AM)

Participants:

- See attendance sheet
- Agency provided introductions and their agency's level of involvement in transportation resiliency. Examples included:

Agency/Department	Examples of How Agency has Addressed Resiliency
ADE Maintenance	• Maintain list of problem areas and flooding issues • Development often cause of flooding • Nowhere to move snow.
OEM	• Updating HMP
MPO	• Worked on NJ and SEPTA vulnerability studies • Working with FEMA to identify strategies to help municipalities
Other	• Chester County: Snow removal, draft identification, flooding, road closures • Bucks County: flooding, drifts, landslides, • Philadelphia: Big change in weather planning, 5 biggest snow storms in X years, Flooding handled thus far, but future flood risk is concerning • Repeat flood spots in Delaware County

Extreme Weather Vulnerabilities:

Extreme Weather Impacts in Region:

- Chester County issues:
  - Creek Road along the Brandywine has erosion issues.
  - 401 has rising project planned
  - 926 bridge replacement
  - Route 1 where Chester County and Delaware County meet - floods on 4-lane road.
  - Drifting becoming worse than the event itself. Few inches turning into 1 foot drifts and causing accidents
- Buckling of roads
  - 422 buckles in hot thunderstorms at joints and doing base repair at joints. One area on 422 fixed and another pops up
  - Route 1 last week in Delaware County
  - Eastbound ramp to City Line
  - Near Doylestown at relief joints
- Wind on high mast lights and sign structures

- Occasional earthquake triggered review of bridge structures
- Flooding, snow, heat seem to be the major climate stressors. Wind / Earthquake secondary issues.
- Sea level rise and storm surge are an issue in Delaware Co.
- Temperature thresholds vary during buckling. No set temperature. (John Krafczyk)
- We know our areas that flood / closures. Routine procedures. Mainly reactive. Limited resources
- City of Philadelphia rep said resources are the primary issue.
- Verizon an issue like other Districts

Strategies to Improve Resiliency:

Examples of Existing Strategies:

- Pumping Stations along I 95 and Vine Street are currently being redesigned. Design contract underway to update and improve pumping stations. 5 locations. Vine/Schuylkill locations and in areas that would flood 95. Designed 60+ years ago.
- Relief joint were installed along Rt. 422 and Rte. 1 to avoid buckling. The joints need to be milled occasionally.
- District stages equipment to open up storm drains / mill joints etc.
- Funding has not been there to make permeant solutions. Often repeating more temporary solutions.
- Focusing on more aggressive foliage removal and maintenance. Focused on site lines and driving factors more than utilities.
- Maintenance staff makes sure manager knows vulnerable inlet locations based on rain/storm predictions.
- PennDOT and municipalities have more needs than funding
    - Poor pavement conditions, structural deficient bridges, capacity issues. If you take $ for vulnerability it is coming from another critical need and vice versa

Other Potential Strategies:

- Find more resources (man power, proactive measures, etc.)
- Tap into early warning systems. (NWS, USGS stream gauges, Murals, INRIX data)
- Silver jackets
- Are there threshold temperatures that trigger, ex 'extra engineer for buckling review on tracks? No, because heat can take so many different impacts. Eyes open or on alert based on different weather predictions.
- Don't typically upsize pipes in District. In urbanized area an increased pipe size impacts everyone downstream. Interrelated systems in historic urbanized area.
- More info on temperature thresholds
- More info on earthquake thresholds
- Our system is tied to municipal system. Need joint watershed approach.
- Often time's storm water is state / local / property owner. Limited funds.
- An RCRS map that is updated frequently would be good for planning purposes. Create drop down menus for slides, buckles, etc.

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District 8 Meeting

District 8-0 Meeting
May 5, 2016
9:00 AM

PennDOT Extreme Weather Vulnerability Study

Meeting Attendance Record

Name	Title	Agency	Telephone	Email
Michele Parsons	EMERG OPS MGR	Cumb Co DPS	218 2917	MPARSONS @ CCPA.NET
Elijah Yearick	Trans Plan. Coord.	TCRPC/HATS	234-2639	eyearick @ tcrpc-pa.org
Gary Isenman	~~PennDot York~~ ALCOM	Penn DOT York	718-6981	Gisherman @ PA. GOV.
Mike Martin	SHMM	PennDOT York	848-6230	MIMARTIN @ PA. GOV
JASON BEWLEY	DB TRAFFIC ENGINEER	PennDOT D8	783-3981	JBEWLEY @ PA. GOV.
Bill DAVIS	DMM	Penndot 8-0	787-4766	WBDAVIS @ PA. GOV
Scott Tangwy	S.H.M.M.	PennDOT 8-7	299-7621	wtangwy @ pa. gov
Dale Good	S.H.M.M	PennDOT-8-5	787-5391	dalgood @ pa. gov
STEVE SAYERS	HMM	PennDot - 8-9	582 2191	SSayers @ Pa. Gov
STEVAN R. DIETZ	SHMM	PENNDOT 8-0	787-4803	STDIETZ @ PA. GOV
Tim Crider	AHMM	PennDOT 8-3	264-4171	tcrider @ pa. gov
ROBERT L BINGAMAN	ACTING HWY MAINT. MNG.	PENN DOT 8-3	264-4171	robbingama @ pa. gov.
Glenn Rowe	CMM	Penn DOT 8-1	334-3155	growe @ Pa. gov

Name	Title	Agency	Telephone	Email
DAN STURM	SHMM	PENNDOT MAINTENANCE	717-243-5414	DSTURM@PA.GOV
DAVE ROCK	ADE-M	PennDOT	717-787-2522	drock@pa.gov.
Dan Wooddell	Geotech	PennDOT	717-787-5217	dawooddell@pa.gov
Randall Gockley	Coordinator	Lancaster County EMA	800-808-5236	rgockley@lancema-us
Sowon Kim	TRANSPORTATION PLANNER	Lebanon County Planning	717-228-4444	skim@Lebcnty.org
Jon Fitzkee	Assistant Director	Leb Cnty Co. Planning Department	717-228-4444	jfitzkee@lebcnty.org
Heather Bitner	Transportation Planner	YCPC	717-771-9870	hbitner@ycpc.org
JEPH REBERT	SR. TRANSPORTATION PLANNER	ycpc	" " "	jrebert@ycpc.org
Tim Singleton	ACMM	Lebanon Co	717 413-4951	Tsingleto@pa.gov
Mike Keiser	DE	PennDOT B-O	717-772-0778	Mikeiser@pa.gov
MIKE SUMMERVILLE	ACMM	PENNDOT	717-848-6230	misummervi@pa.gov

PennDOT Extreme Weather Vulnerability Study
District 8-0 Meeting Notes
May 5, 2016 (9:00AM)

Participants:

- See attendance sheet
- Agency provided introductions and their agency's level of involvement in transportation resiliency. Examples included:

Agency/Department	Examples of How Agency has Addressed Resiliency
Traffic Engineering	• Use flood maps as a tool to plan strategies
Lebanon County Planning	• Zoning ordinance changes • Involvement in hazard mitigation planning
Lebanon County Maintenance	• Identify current flooding locations • Utilize information for maintenance planning
York County Planning	• Conducting vulnerability study
TCRPC	• Recommended strategies at select locations
Cumberland County Dept of Safety	• Information sharing
GeoTech	• Assessment of vulnerabilities including slope issues
Maintenance Manager	• Apply planning methods and strategies • Aware of problem areas
Perry County Maintenance	• Identified problem areas
Franklin County Manager	• Traffic management
Dauphin County Manager	• Focus on quick response • Relaxed inventory control (extra stone, materials, paving equipment)
Lancaster County Manager	• Plans in place for snow and flooding
District Engineer	• Inventory control (salt inventory in District 8 is best practice) • Partnering may help among municipalities

Extreme Weather Vulnerabilities:

<u>Data Sources for Vulnerability Locations</u>:

- PennDOT Road Closure Data
  - Good for higher classification roadways (data often screened), Lower class roadway data is often less reliable
  - Some repeated flooding locations may not be included in the database
  - Populated differently depending on the District
  - In District 8 this is input by Traffic Management Center – Information is validated prior to submitting to avoid double counting of events)

- District Traffic Management Center (TMC) has information/data of events
- Army Corps of Engineers information on dams (example York Indiana Rock Dam facility)
    - YCPC provided example of their requests to Army Corps regarding the Indian Rock Dam impacts on transportation system
- 911 Data Centers
- Crowd Sourcing Apps (WAZE)
- Pennsylvania State Police (PSP)
- Maintenance personnel know key locations
- PEMA information
- PSATS may be another good resource
- County and Township Staff (locals know the issues)

Extreme Weather Impacts in Region:

- Excess rain and snow are key issues in region
    - District 8-0 becomes vulnerable when it rains 2-4 inches with high winds
- River levels trigger flooding in other areas
    - Example - Dauphin Narrows floods once Susquehanna reaches 21'
- High wind events result in trees falling on roadways, utility work/repairs affecting facilities
- Utilities are often key reason roads are closed for extended times and create safety issues:
    - Trees / telephone poles in ROW, inside of 20' of roadway.
    - Poles that fall limit the DOT from removing and working on trees
- Impacts of over-development include increase of impervious areas, which increases flooding/runoff
- Detours caused by closures – longer detours/traffic impacts for critical roads and bridges
- Farming practices can result in sediment and runoff that clog pipes. Removing of fence rows/trees causing snow drifts onto the roadways
- Sediment flowing into the streams causing significant resources to restore the streams
- Debris in streams/ drainage causing damage to roadways
- Tornados have created issues where utility poles were down. Response of utility companies impacted duration of roadway closures.
- Roadway/bridge clearances – need/requirement for inspections prior to opening – timing of inspections. Protocols in place based on type of bridge and severity of flooding. Delays and closures often related to time needed to inspect bridges or roadways
    - Some indicated that more information on vulnerabilities may not help in speeding this process up
    - In past some closures have involved political officials due to extensive delays
    - In York, bridge foreman has personally inspected bridges to speed process

Other Asset Characteristics That Impacts Vulnerability:

- Design of bridge to handle pressure flow conditions.

Critical Assets:

Factors Affecting Determination of Critical Assets:

- Maintenance departments currently use roadway functional class and AADT to prioritize maintenance and inspection activities
- TCRPC encouraged critical assessment to take into account not only the populations served in the calculations of how critical a piece of infrastructure is, but also weight that rating with the number of people who solely rely on a particular piece of infrastructure for access.
    - The most prominent example in the Harrisburg region is Middle Paxton/Dauphin Borough. During the flooding associated with Tropical Storm Lee the US 22/322 underpass flooded shut. This combined with the flooding at Clarks Ferry and with other surface streams in the township, resulted in the area being isolated from the rest of the region. While a broad view of the region might mitigate the closure of US 22/322 because of the alternative presented by US 11/15, TCRPC encourages that these isolated populations to be also taken into account. A larger issue is that in a similar event, much of upper Dauphin County would also be cut off from access to emergency medical service. I've been told the closest alternative hospital would be Sunbury, though that may be overlooking smaller facilities.

Examples of Critical Assets and Data Sources:

- South Central Task Force has done work on all hazard incident management. They may have information on critical assets.
- The nuclear power plans (TMI) have emergency evacuation routes which are available to the public.
- Other data sources include PEMA, Homeland Security, EMS, and evacuation routes from RITIS (access from University of Maryland (Nikola Ivanov ivanovn@umd.edu(
- Some of the MPOs have done work to identify critical assets
    - TCRPC will provide example locations that they have identified, like in Dauphin / Clarks Ferry Bridge which are sole access points.

Strategies to Improve Resiliency:

Examples of Existing Strategies:

- Coordination and Training
    - District 8 planning efforts with employees
        - Weather reports and district wide webinars to coordinate plans including operation and maintenance strategies.
        - Dry-run of snow routes
        - What if scenario planning
        - Pre-storm meetings including coordination with PEMA and Central Office (documentation on processes may be available from Steve Dietz)
    - Statewide equipment needs are coordinated with other PennDOT Districts across the state

- County Manager conducts an annual meeting with emergency responders
- Traffic Incident Management (TIM) teams and SHRP2 training
- Central Office coordination efforts with townships and boroughs.

- Data Analyses and Information Sharing
  - RCS / 511 information dissemination
  - District 8 has used National Weather Service Hydrographs for planning purposes.
  - TMC monitoring and updating of ITS signage in region

- Maintenance and Inspections
  - PennDOT's Project Downpour used to determine inspection frequency and priorities
  - District site visits to check and remove debris at known flood areas.
  - Maintenance procedures for critical events in place; however they are not always documented.
  - Inventory control. Stockpile material for flood damage.

- Design
  - Upsizing of pipes based on allowable values in maintenance manual.
  - Rain gardens integrated into highway designs (Daryl St. Clair)
  - Headwalls on larger pipes to reduce damage of pipes/culverts due to "blow outs".

- Technology/Equipment
  - Pressure flow/ pumps working to avoid flooding

Other Potential Strategies:

- Coordination and Training
  - More coordination with townships. Flooding is often a local issues
  - Action plans for extreme events, example when RT322 floods to implement diversions
  - Coordination with other partners. Example, townships are responsible for storm water management and development.
  - PennDOT currently has personnel directly involved with nuclear (TMI, Peach Bottom) evacuation planning. Apply similar strategy and include PennDOT personnel in emergency management agencies. Emergency management call information could be transferred to PennDOT.
  - Improve coordination:
    - PSATS (municipalities/townships) – educations, overdevelopment issues, farming issues on drainage, other practices
    - PaDEP – cutting trees and clearing along roadways
    - US Fish and Wildlife Agency / Soil Conservation – Permits and clearances currently take too long
    - DCNR – oversee dams
    - PNDI environmental studies – endangered species - not efficient to get clearances
    - Utility companies
  - Integration of state's full time meteorologist. Better forecasting and coordination within the Department
  - Identify potential funding sources for strategies

- Data Analyses and Information Sharing
    - PennDOT protocols for relaying information to and from 911

- Maintenance and Inspections
    - Remove trees along PennDOT roadways reducing weather impacts of falling trees on utility lines and roadway
    - Methods to improve response for inspections of roadways and bridges.
    - Improve situational awareness. Have maintenance crews monitor storms and relay information back to District offices to make decisions on manpower and needs.
    - A recent earthquake highlighted the lack of current protocols for addressing potential impacts. A protocol documenting potential earthquake intensity (Richter scale) impact on bridges would be beneficial to addressing potential closures or inspections.
    - Continued improved practices for inventory control. Stockpile material for flood damage.

- Technology/Equipment
    - Improved policies on use of swing gates for more quick responses to close roadways for first responders
    - Improved method to expedite bridge and roadway inspections after storm events. One idea is for Districts to have their own drill rig to get borings and to test roadway safety (sink holes). District 3 currently has one.
    - Work is underway with the Susquehanna Basin Commission to post web cameras on poles for real time monitoring of conditions at selection locations of historic flooding. This has been applied at several current locations and several more proposed. Future integration at other vulnerable areas may provide more information to make quick decisions and responses.
    - Integration of automated warning systems to establish road closures and listed alternative routes to the public. Evacuation routes could be determined for frequently flooded locations identified from the study.
    - Future practices at the Traffic Management Center including cameras on maintenance vehicles could improve storm impact monitoring.
    - Flood monitoring system – similar to traffic cams, to monitor flood stages

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District 9 Meeting

District 9-0 Meeting
May 26, 2016
1:00 PM

pennsylvania
DEPARTMENT OF TRANSPORTATION
Michael Baker
INTERNATIONAL

PennDOT Extreme Weather Vulnerability Study

Meeting Attendance Record

Name	Title	Agency	Telephone	Email
William D. Oleksak	District Maint. Mgr.	Penn DOT 9-0	814 696-7129	woleksak@pa.gov.
Michael P. Peachey	9-5 Manager	PennDOT 9-5	814-559-0566	mpeachey@pa.gov.
TONY TANZI	Signals + ITS Section Supervisor	PennDOT 9-0	814-696-6855	ttanzi@pa.gov
SCOTT A. ROBERTS	ASST. DIST. BRIDGE ENGINEER - INSPECTION	PENN DOT 9-0	814-696-6853	SCROBERTS@PA.GOV
Kevin Stern	MAINT. SERV ENGR	PENNDOT 9-0	814-696-7120	Kstern@PA.GOV
WALLY TOMASSETTI	ADEM	" "	814 696 7176	wtomassetta@pa.gov
Jeff Mitchell	County Manager	Cambria County	814 472 7100	Jomitchell@pa.gov
MARK J. YERKEY	SHMM	PA DOT 091/0970	814-623-6144	MYERKEY@PA.GOV.
Frank A Beudeck	AHMM	PA DOT 0970	814-445-7405	fbeudeck@PA.GOV
RON SPRINGER	County Coord.	Cambria Co. EMA	(814) 472-2050	rspringer@co.cambria.pa.us
Steven J Gracey	AHMM	PennDot 9-1	(814) 623-6144	stgracey@pa.gov
Rodney Baiter	AHMM	PennDOT 9-3	814-419-1152	rbeiter@pa.gov
Gloria Collier	Assistant Engr Geotech	9-0	814-696-6822	gcollier@pa.gov

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Name	Title	Agency	Telephone	Email
Kevin A Eckenrode	AHMM	Penn Dot	814 643-0150	keckenrode@pa.gov
Randy Barrick	AHMM	Penn Dot	717-485-3516	rabarrick@pa.gov
Joseph Kelemen	Maintenance Manager	Penn Dot 9-7	814-445-7905	JKelemen@pa.gov
Joel D. Landis	Logistics/Training	Somerset Co EMA	814-445-1515	LandisJ@co.somerset.pa.us

PennDOT Extreme Weather Vulnerability Study
District 9-0 Meeting Notes
May 26, 2016 (1:00PM)

Participants:

- See attendance sheet
- Agency provided introductions and their agency's level of involvement in transportation resiliency. Examples included:

Agency/Department	Examples of How Agency has Addressed Resiliency
Cambria EMS	• Good relationship with PennDOT. • Implemented welfare safety checks for stranded motorists.
Bridge Engineer	• Central Office Bridge Watch has improved identification of needs and protocols for follow-up inspections
ACM	• Awareness stage • Know problem areas • Focusing on development of detour routes
ADE Maintenance	• Winter weather key issue • Working to improve situational awareness

Extreme Weather Vulnerabilities:

Data Sources for Vulnerability Locations:

- County EMA has platforms for data sharing.
- County EMA has conducted commodity flow studies and integrated information into hazard mitigation plans (e.g. can identify hazard materials flow).

Extreme Weather Impacts in Region:

- Tornado affected SR219, cleanup required
- 2 locations where beaver dams have affected roadways (flooding)
- Retaining wall failures (District has inventory of retaining wall locations)
- 50-100 locations have potential for rock slides (District has inventory, Greene-Fayette are high prone areas)
- Impacts of flooding resulted from undersized culverts
- Shoulder draining and slopes are key issues
- Ice jams at Rt53 affected bridge integrity (low clearance)
- Abandoned mine shafts and sinkholes
- Heavy rain and ice storms result in trees down – utility impacts
- Response to trees down (Power companies responsive, Verizon more difficult to respond quickly)

- Runoff from developments are a key issue. For example Somerset Borough does not have funding to upgrade undersized pipes. Many issues with these systems included old tin or terracotta pipes. Often difficult to address the problems.

Strategies to Improve Resiliency:

Examples of Existing Strategies:

- District has dug blind ditches to provide some drainage near roadways. Economic alternative but may not always solve the problem.
- Winter webex to prepare for storms and share information.
- Somerset joint utility meetings are held every quarter to discuss projects.

Other Potential Strategies:

- More communication between design-construction-maintenance personnel within PennDOT when designing a project.
- Improve methods and funding for debris removal.
- Better preplanning and protocols for designating a governor travel ban and other restrictions
    - District 10 testing 45 mph speed limit and right lane only for trucks – reductions in accidents during events – however may not work in other areas due to the number of trucks on roadway
    - Where to put commercial vehicles if major event results in shutdown
- EMA conducts training for emergency events. Would welcome PennDOT to these training sessions.
- More information needed for public on blue/red detour routes. Public does not have good understanding – County EMA gets calls on these from public.
- Armoring street banks is important. District has done some work on this. Difficult to work in streams due to permits needed. Takes a lot of steps to do quickly. Follow Vermont's lead in first containing the water than designing the roads. Must balance with potential costs.
- Google maps for detours
- Hold joint meetings with utility companies on a quarterly basis

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District 10 Meeting

District 10-0 Meeting
May 26, 2016
8:00 AM

PennDOT Extreme Weather Vulnerability Study

Meeting Attendance Record

Name	Title	Agency	Telephone	Email
Ryan Gordon	Planner	SPC		rgordon@spcregion.org
Rick Gill	CE Manager	PennDOT	7243572428	rigill@pa.gov
Joe Dukovi	DE	PennDOT D10	724/357-2806	jdukovi@pa.gov.
Jack Clinger	CMM	PennDOT 10-3	814 226-8200	jclinger@pa.gov
Jeff Hartzell	ACMM	PennDOT 10-3	724 284 8200	jhartzell@pa.gov
Tom Stutzman	DIR EMA	IND. CO. EMA	724-349-9300	TSTUTZMAN@INDIANACOUNTY.ORG
Lauren Miller	Intern - ESTI	PennDOT 10-0		Laurenmill@pa.gov
Tatianna Schilling	Intern - ESTI	Penndot 10-0		tatschill@pa.gov
Bill Clement	Emerg. Mgt Specialist	PEMA	724-357-0108	wclement@pa.gov
John R Serian	CMM	PennDOT	724-357-2817	jserian@pa.gov

PennDOT Extreme Weather Vulnerability Study
District 10-0 Meeting Notes
May 26, 2016 (8:00AM)

Participants:

- See attendance sheet
- Agency provided introductions and their agency's level of involvement in transportation resiliency. Examples included:

Agency/Department	Examples of How Agency has Addressed Resiliency
MPO (SPC)	• Involved in TIP development, Between awareness and assessment
County Manager	• React to situations • In some cases conducted informal strategies including additional pavement thickness to address repeat flood location
District Executive	• Some advanced preparation before storms, know locations where flood will impact first • Hard to anticipate impacts for some storm events
Bridge Engineer	• Assessment of scour critical bridges, plans in place for storm events, document damage
EMA (Indiana)	• Identifications of roadway loss part of hazard mitigation plans • Hazard mitigation is a municipal process but the county performs for all municipalities. • Have used some hazard funding for mitigation, which has included some bridge replacements

Extreme Weather Vulnerabilities:

Data Sources for Vulnerability Locations:

- National Weather Service has historical closure data archives and plots of storm events
- SPC has some data on areas prone to landslides but this information is old (from 1970s)
- County EMA Knowledge Center Database is a framework for database management
- Districts GIS database of detour routes
- Hazard Mitigation Plans

Extreme Weather Impacts in Region:

- Coal and acid mine drainage have degraded old metal pipes under many of the region's roadways. These pipes are collapsing and blocking drains. Impacts along I-80 are significant with high costs to repairs these drainage systems.
- Plastic pipes less than 3feet underground more susceptible to washouts.

- Some heat issues related to pavement joint buckling.
- Ice jams on the Allegheny River which have impacted roads
- Dams have impact flooding on roads.
- Mine subsidence and sinkholes
- Much of flooding is flash flooding … gone after 2 hours.
- Limited coordination between PennDOT and the utility companies with respect to tree cutting.
- New development and runoff is a major issue in the urban areas.

Factors for Determining Consequence:

- Scour bridges
- NHS Bridge Detours
- Weight restricted bridges

Strategies to Improve Resiliency:

Examples of Existing Strategies:

- Calibrate pipe size selection with input from landowners and municipalities. When replacing pipes initial values for pipe diameter are estimated from design software. Before finalizing these values, contact is made with adjacent landowners / municipalities on historic flooding impacts nearby. If input indicates a problem then potential increases to design standards may be made.
- Coordination with Army Corp of Engineers for impacts from Dams. Coordinate with EMS on potential communities that may become landlocked.
- Review of riprap sizing and possible upgrade in rock size at locations where rock can wash away.
- More careful consideration of use of plastic pipes as they may flex or wash away if less than 3 feet underground. If less than 3 feet and plastic pipes are needed then concrete headwalls are being used.
- Inventory of impacts of Gypsy Moth and Emerald Ash Borer on trees along state roadways. Identified number of trees and costs to address ($8million). No contract mechanism to get these completed.
- Permanent flip signs at locations that repeatedly flood.
- PEMA and National Guard pre-stage for major events. These efforts have involved the utility companies. Knowing locations of flooding may not have large benefit as region has minimal number of recurring spots that have big impact on transportation.
- A portable bridge has been purchased by the County. EMA may end up owning it.

Other Potential Strategies:

- Consideration of risks using a vulnerability vs risk matrix.
- More efforts needed to armor stream banks and slopes as preventive measures. Proactive approaches similar to what Vermont is now doing. Designing for water first then investigate how transportation system can fit in.
- Better planning for inspection standards related to earthquakes and tornados.
- Options to remove trees along right-of-way.

- EMA would see benefit in visualizing RCRS data on historic flooding locations. They would like to decipher from RCRS what is an emergency closure vs. a scheduled closure.
- Better descriptions in RCRS would assist in planning applications.
- Better coordination with Army Corps on Dam levels.
- Permanent signs at repeat flooding locations. Signs with flashing lights are more effective than flip signs.
- More funding for maintenance and technology solutions.
- Better ways to effectively manage data like the County EMS Knowledge Center Database. Need to identify historical vs live data.
- Important goal of this PennDOT study should be to identify the roles of each of the agencies involved. Where does each fit in? Hazard mitigation process may serve as template.
- District 10 conducting a pilot to integrate PEMA/911/RCRS data.
- Overlay common detours with flood prone areas

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District 11 Meeting

District 11-0 Meeting
July 12, 2016
8:00 AM

PennDOT Extreme Weather Vulnerability Study

Meeting Attendance Record

Name	Title	Agency	Telephone	Email
David Lancaster	AHMM	PennDOT	724-656-3104	dalancaste@pa.gov
Kevin Chatasky	AHMM	PennDOT	412-292-9327	kchatasky@pa.gov
Dave Harding	AHMM	PennDOT	724-333-6049	daharding@pa.gov
Bill Schlott	AHMM	PennDot	412-292-9312	WISCHLOTT@PA.gov
Lou Ruzzi	DIST. BRIDGE ENGR	"	412-429-4893	LRUZZI@PA.GOV
Andy Waple	[redacted] Program Dev. Mgr.	SPC	412-391-5590	awaple@spcregion.org
DEAN POLETTI	MAINT. SERVICES Engineer	PENNDOT	412-429-5059	dpoleti@pa.gov
CARMEN ANGOTTI	PHMM	11-1 MAINT	412-249-9324	CANGOTTI@PA.GOV
Shane Szalankiewicz	D.G.E	PennDOT	412-429-4904	sszalankie@pa.gov
ANGELO PAMPENA	ADE MAINT	PENNDOT	412 429-5002	apampena@pa.gov.
DEAN SCHMITT	AHMM	PENN DOT	412 292-9326	DESCHMITT@PA.GOV
H.D. CESSNA	PE	PENNDOT	412-429-5041	hcessna@pa.gov
Jonathan Moses	Asst. Dist. Bridge Engineer	PENNDOT 11-0	412-429-4897	jmoses@pa.gov

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Name	Title	Agency	Telephone	Email
Costa Samaras	Professor	CMU	412 268 1658	csamaras@cmu.edu
Floyd Butler	HMC	PennDot	7246240609	flbutler@pa.gov
Michael Simmons	County Manager	PennDot 11-2	724 7744076	Micsimmons@PA.Gov

PennDOT Extreme Weather Vulnerability Study
District 11-0 Meeting Notes
July 12, 2016 (8:00AM)

Participants:

- See attendance sheet
- Agency provided introductions and their agency's level of involvement in transportation resiliency. Examples included:

Agency/Department	Examples of How Agency has Addressed Resiliency
ADE - M	• Some strategies implemented like for 10th street bypass • Watch areas determined
Maintenance	• Ensure pipes clear from debris
Highway Manager	• Sign and crews prepared before storm events
Bridge Engineer	• Webinars before storms, Prep for inspections • NWS projections of areas that could be impacted
DE	• Ensure people resources are available to prepare for events
Assistant Manager	• Coordinate action plans • Preventive maintenance • Ensure equipment ready
GeoTech	• Slope failure remediation

Extreme Weather Vulnerabilities:

Extreme Weather Impacts in Region:

- Flooding (both due to rain, storms and snow melt), slides and downed trees are key weather-related impacts affecting the region. Steep terrains create many slide and rock fall issues.
- Unchecked local municipality storm water run-off impacts PennDOT system. Trying to work with municipalities to clear debris from local systems.
- Unchecked development has led to major flooding issues
    - DEP sets policies, municipalities develop ordinances, Who owns stormwater?
- Aging conditions of pipe system of major concern
- Steel pipes have collapsed due to development over top (lack of design planning for new development)
- Silting of culverts is a major issue. Need DEP assistance / approval.
- Aging condition of tin whistles an issue
- Heat has caused buckling of roads but it is not a major issue. Methods to address exist.

Data Sources:

- Maintenance IAQ
- Bridge Watch Software
- Winter Sentry

- Endeca

Strategies to Improve Resiliency:

Examples of Existing Strategies:

- Contractor low bidding process often limits ability to design to higher standards
- Some strategies implemented include those for 10th street bypass (unique situation may not be a case study for other regions):
    - Have plans, cameras, monitoring and alarms
    - Sign crews prepared
    - Only closed 3 times in last decade
- Flood warning system installed with City of Pittsburgh
    - Washington Blvd, SR 8
    - Inadequate storm system in city
    - Estimated over $1billion to fix
    - PennDOT working to install warning systems
- Dredging to address steam issues
    - For example would be needed in "Streets Run Road (SR 2036)" – this is typical of many other areas in District
    - Floods during many rain events
    - Creek higher than the road
    - Dredging needed in streams but difficult to obtained necessary DEP permits
- Improved maintenance techniques including riffraff to address Scour (Route 8)
- PennDOT wanted to armor some walls but got push back from DEP and some levels of PennDOT
- Geotechnical work serves as good example of practices
    - Monthly planning meeting between geotech staff and maintenance personnel to discuss slide locations
    - Thinking more about armoring shoulders and improving construction techniques
    - Summarize details on installation
    - Contract mechanism in place to address slides quickly
    - Trying to do best practices
    - Training presentations for DOT staff
- Bridge unit has maintenance contract to address needed improvements 50ft upstream and downstream of bridges
    - Armoring banks
    - After storms bridge contractor clears debris
    - Bridge washing contract to clear road debris and drains
- Current cycle clearing maintenance program
    - Working
    - Potential improvements could include cameras, predictive analyses, use of more data
- Participate in scope and field views
    - However municipalities are not yet attending these. Locals don't have the capacity.
- PennDOT Agility Program
    - Sharing of resources – agreements for in-kind services with county, municipalities and PennDOT

- Daylighting programs underway to remove trees along roadways. Though funding limited to do comprehensive cutting.
- Liberty Bridge – storm water rain gardens used. Other technologies may be useful including asphalt to hold water so it can evaporate.

Other Potential Strategies:

- Some pipes need expanded (funding)
- Additional funding needed to address resiliency
- More standards needed for post earthquake inspections
- We need an easy way to capture flooding history (through an existing IT system) with drop down boxes
    - Can Maintenance IQ help?
    - What about the new Bridge Watch Software? Crystal Newcomer
    - Winter Sentry. (check with Jay Smyser)
    - Endeca
    - BMS shows bridge flooding
    - Need Flood assemblies in SAP to query.
    - A map to assist Maintenance Crews in identifying flood prone areas needing repair (pt. a to pt. b), would be useful. Identifying clusters of vulnerabilities
    - A map showing slope failure clusters would be useful.
- Plan for storm water management using a watershed approach.
    - Example Saw Mill Run Study (SR 51/88 intersection)
    - Could be provided as case study example (get from Ruzzi)
    - Involved PennDOT, borough and DEP
- Constantine Samaras (CMU) indicated there may be more federal resiliency funding in future. Those with plans may have a better shot at getting $$.
- Improve design of bridge abutments
    - Rock placement
    - Windwalls wider
- Underwater inspection reports to help with rehab
- Raised curve and asphalt wedges
- Flooding coincides often with grass cutting
    - Grass cutting clogs inlets
    - 3 grass cutting cycles (memorial day, 4th of July, Labor day)
    - Possible mulching needed
- CMU working on design study (obtain summary information from Constantine Samaras)
- SPC recommended that resiliency information be incorporated into PennDOT's INDECA system which ties together databases to analyze investments.
- Future data systems need to talk and share information to make it easy to use for District staff
- Certified people and equipment are needed to address storm events
    - PennDOT has caps on number of operators for equipment. Some caps are implemented to ensure proficiency.
- CMU recommended more efforts to track and understand past maintenance dollar spending over time. Where is money lacking. Identify proactive strategies. Arizona DOT is conducting such efforts.
    - Work with DEP to develop watershed approach for system resiliency

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District 12 Meeting

District 12-0 Meeting
May 25, 2016
8:00 AM

PennDOT Extreme Weather Vulnerability Study

Meeting Attendance Record

Name	Title	Agency	Telephone	Email
Chris Tantlinger	DEMC	Westmoreland DPS	724 640 6601	ctantlin@co.westmoreland.pa.us
Tim Hallam	WC DPS Ops Chief	" "	724-640 6600	THallam@co.Westmoreland.pa.us
DON HERBERT	DIST. BR. ENGR.	PENNDOT DIST. 12	724.439.7311	dherbert@pa.gov
Ron CLARK	ADEM	"	724-439-7256	ronaclark@pa.gov
Martin Rapsack	ACMM	PennDot 1240	724-223-4450	MRapsack@PA.GOV.
Andy Waple	[redacted] Program Dev. Mgr.	SPC	412-391-5510	awaple@spcregion.org
Jerry Simkovic	CMM	PENNDOT Greene	724 627-6131	JESimkovic@PA.GOV
Adam Smith	CMM	PennDOT 1240	724-223-4450	adasmith@pa.gov
Rich MARTIN	ACMM	PennDOT 1210	724 4397470	RAMARTIN@Pa.GOV
Chris Sleighter	CMM	PENNDOT 1210	724-439-7470	csleighter@pa.gov
Robert J. Joe	ACTING DMM	PENN DOT 1200	724 439-7333	rjoe@pa.gov
Corey E Howell	AHMM	PennDOT 12-5	724-433-1706	Cohowell@Pa.gov
Rob Dean	CMM	PennDOT 12-5	724-832-5387	robdean@Pa.gov

Name	Title	Agency	Telephone	Email
Tim Cook	Acting Maintenance Services Engineer	PennDot District 12-0	724-430-4495	timcook@pa.gov.
J J. SZCZUR	D.E.	PDOT D-12	724-439-7340	JSZCZUR@PA.GOV.
JEREMY HUGHES	ASST DIST. BRIDGE ENG (DESIGN)	PADOT 12-0	724-439-7264	JLHUGHES@PA.GOV
Steve Hoyer	Asst. Distr. Bridge Engineer	PA DOT Dist 12	724 439 7266	sthoyer@pa.gov

District 12-0 Meeting
May 25, 2016
8:00 AM

pennsylvania
DEPARTMENT OF TRANSPORTATION
Michael Baker
INTERNATIONAL

PennDOT Extreme Weather Vulnerability Study

Meeting Attendance Record

Name	Title	Agency	Telephone	Email
Corey Cook	ESTI - Geotech	District 12-0 Geotech dept	724-331-4390	corcook@pa.gov
RACHEL DUDA	ADE-D	12-0	724-439-7259	rduda@pa.gov
Steve Marsinko	Quality / Emg Coord	12-0	724-439-7238	Smarsinko@Pa.gov
Guy NaPoLillo	9-1-1 Coordinator	Fayette EMA/9-1-1	724-430-1277	gnaPolillo@FCemo.org
Vince Sherwood	9-1-1/GIS	Fayette EMA	724-430-1277	Vsherwood@fcema.org
JASON SPANGLER	DMM	PA DOT 12	724-323-6534	JASspangle@pa.gov
KENNETH SHIMKO	12-0 CONSTRUCTION S.C.E.	PENNDOT	724.439.7167	KSHIMKO@PA.GOV
William L. Kovach	ADE-C	Penn DOT Const.	724-439-7137	wkovach@pa.gov

PennDOT Extreme Weather Vulnerability Study
District 12-0 Meeting Notes
May 25, 2016 (8:00AM)

Participants:

- See attendance sheet
- Agency provided introductions and their agency's level of involvement in transportation resiliency. Examples included:

Agency/Department	Examples of How Agency has Addressed Resiliency
District Executive	• Agency primarily at assessment level, React to extreme weather impacts, Know typical areas of flooding though unique locations often occur with extreme events
County Managers	• Aware of stream flooding locations due to flash flooding • Identified slide areas
County Public Safety	• Focus on public awareness • Working on communication between first responders and PennDOT
ADE Maintenance	• Bridges have been shut down due to past flooding, monitoring scour locations
MPO (SPC)	• SPC Draft TIP includes $24 million for slide projects • This District spends highest amount on slide and mine subsidence issues in the state. • MPO identifies projects through workgroup meetings with PennDOT District staff.

Extreme Weather Vulnerabilities:

Data Sources for Vulnerability Locations:

- University of Pittsburgh was investigating possibility of during a study assessment of regional geology to predict locations of high slide likelihood. However this study never got started. PennDOT District would be interested in such a study in future to help in identifying locations and methods to prevent.
- Army Corps of Engineers should be contacted for potential flooding locations as related to impacts from dams.
- RCRS data may have the bridge ID coded which would allow for linkages to bridge scour ratings.

Extreme Weather Impacts in Region:

- Greene and Washington counties have the highest slide tendency in state. Over 100 slide locations have been inventoried. Some slides have occurred on I70 and I79.

- Unique mountainous terrain results in flash flooding. Has impacted and washed away some smaller bridges in the region.
- Snow events have created transportation issues.
- Ice on mountain ridges have resulted in trees down and utilities being impacted.
- Municipality drainage systems are overwhelmed during heavy rain events. These flooded roads have impacted state road systems.
- Meandering streams near roads cause many problems.
- Snow drifting is of concern (example Route 31 in Westmoreland County. District not aware of any standards for accounting for drifting within design manuals.
- Mine subsidence also an issue.
- Delay in utilities responding to downed trees is an issue
- Fire departments understaffed. Unwilling to remove trees unless emergency.

Critical Assets:

Factors Affecting Determination of Critical Assets:

- Pedestrian impacts of flooding

Strategies to Improve Resiliency:

Examples of Existing Strategies:

- Bridge post flood inspection activities are conducted per PennDOT Publication 238.
- Each county has list of the slide locations and priorities.
- District staff maintain book of detour plans. Reviewing critical areas to improve detour routes and alternatives (identifying additional considerations like wide truck loads and weight restrictions).
- Early ordering of materials including salt. Addressing storage issues. Stockpile redundancy (there are only 6-7 piles in Washington County … if you lose one it could be significant)
- Somerset County EMA has quarterly meetings with utilities to discuss issues
- 10 year plan was developed to make detour routes more resilient

Other Potential Strategies:

- More efforts needed to armor stream banks and slopes as preventive measures. Proactive approaches similar to what Vermont is now doing. Designing for water first then investigate how transportation system can fit in.
- Methods to account for snow drifting in designing roadways.
- More coordination on addressing extreme weather events with adjoining states (e.g. WV, MD) along border locations.
- Expansion of ITS to assist in monitoring storm activities and impacts.
- Future study to help in identifying locations and methods to prevent slides / mine subsidence / sinkholes.
- In this region, the fire department is no longer responding to trees down. PennDOT may need more protocols for addressing downed trees during storm events. Other preventative actions

may be beneficial. In District 10, an inventory of dead ash trees was conducted along state roads. However, it would take a large amount of money to remove these trees which that district does not currently have.

- Better coordination and communication needed with utility companies to improve their response for more minor events. More protocols in place for major events.
- Extra height delineation along higher snow routes has been tested successfully in the region.
- County EMA believes communication is typically the biggest issue for flooding and other extreme weather events. Possible improvements would include having one single point of contract from PennDOT for 911 calls.
- Possible dedicated resiliency staff person at Districts to lead resiliency efforts and coordination.
- Difficult to address upstream/downstream maintenance of drainage systems off PennDOT's system or beyond their right-of-way. Example: May upgrade pipe to 18in but may create new problems downstream on private or local land or infrastructure.
- More opportunities for use of the RCRS system:
    - RCRS training exercises (done by District a few years back as part of the Continuity of Operations Planning – COOP) The COOP required each department/agency to establish and maintain a COOP that identifies delegation of authority and order of succession, responsibilities, essential functions, key personnel, vital records management and emergency duty location. These training exercises improved situational awareness and allowed testing of different types of scenarios which highlighted some deficiencies.
    - RCRS updates have already been recommended. Central office may have listing of these as identified through a previous review process.
    - Integrate interactive map with RCRS
    - More outputs from RCRS so they can be used for planning purposes
- Are there any tools to help in determining diversions (on the fly?)
- Additional funding sources (ACOE, FEMA)
- Discuss permitting to remove streambank silt with DEP.